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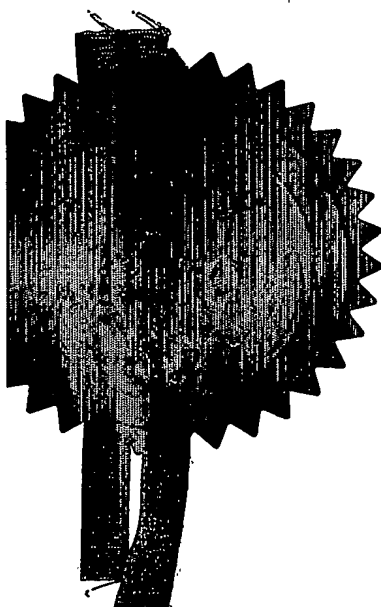
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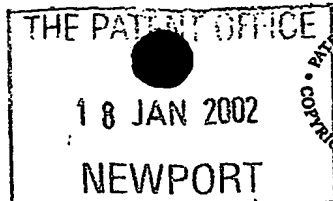


Signed

Dated

R. Mahoney

18 MAR 2003



1/77

18JAN02 E688954-2 D10002
P01/7700 0.00-0201106.2

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1. Your reference sps.2025.uk.dk/ac.b

2. Patent application number 18 JAN 2002
(The Patent Office will fill in this part) 0201106.2

3. Full name, address and postcode of the or of each applicant (underline all surnames)

SPS-AFOS Group Limited
Arnhall Business Park
Westhill
ABERDEEN
AB32 6TQ
United Kingdom

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

UK
8501398001

4. Title of the invention Disengageable downhole tool

5. Name of your agent (if you have one)

Kennedys
Floor 5, Queens House
29 St Vincent Place
GLASGOW
G1 2DT
United Kingdom

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

Patents ADP number (if you know it) 8036758002

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number	Country	Priority application number (if you know it)	Date of filing (day / month / year)
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7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	Number of earlier application	Date of filing (day / month / year)
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8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

Yes

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

Patents Form 1/77

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Continuation sheets of this form

Description 15

Claim(s)

Abstract

Drawing(s)

4 *sc* *He*

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Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (*Patents Form 7/77*)

Request for preliminary examination and search (*Patents Form 9/77*)

Request for substantive examination (*Patents Form 10/77*)

Any other documents
(*please specify*)

11. I/We request the grant of a patent on the basis of this application.

Signature
KENNEDYS

Date
17 January 2002

12. Name and daytime telephone number of person to contact in the United Kingdom
David Kennedy
tel: 0141 226 6826

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1 Disengageable downhole tool

2

3 The present invention relates to downhole tools for use
4 in the oil and gas industry and in particular although
5 not exclusively to a disengagable downhole tool which
6 allows a tool to be disengaged from a work string in a
7 well bore and later retrieved on the work string when the
8 work string is removed from the well bore.

9

10 In drilling or completing a well, each stage requires a
11 work string to be made-up which includes any tools
12 required within the well bore. Typically once made-up the
13 work string is inserted in to the well until the tool
14 reaches the desired location, the job is undertaken and
15 then the work string including the tool is returned to
16 the surface. As a number of jobs are required in a well
17 in order to drill and complete the well, this can require
18 a great number of trips into the well by a work string.
19 Each time the string is retrieved, made up and reinserted
20 time is lost which increases the cost involved in
21 drilling and completing the well.

22

1 It has long been known to combine tools on a single work
2 string. However, some tools such as the drill bit can
3 only be located at a single position on the work string
4 e.g. at the base.

5
6 An example where a single tool is required to be placed
7 on a work string is in the milling of a polished bore
8 receptacle. A polished bore receptacle is typically
9 positioned at the top of a production liner in
10 conjunction with the liner hanger disposed in a well
11 bore. The polished bore receptacle typically has a long
12 polished bore, which slideably and sealingly receives a
13 sealing assembly on the end of a tubing string. Due to
14 its function of requiring a surface against which a seal
15 can be made, the polished bore receptacle which is
16 inserted into the well is generally milled and dressed to
17 provide an ideal surface finish. Such milling and
18 dressing of the receptacle and in particular the top
19 portion of the liner requires a single trip into the well
20 and a suitable milling assembly.

21
22 Where multiple tools can mounted on a single work string,
23 difficulties can arise in the need to co-ordinate the
24 activities of each of the tools independently from each
25 other, particularly, if one tool is required to work
26 before or after the operation of another tool.

27
28 Further difficulty arises when a tool, in order to
29 operate, must come into contact with a portion of the
30 well bore lining or casing. In these circumstances, the
31 tool must be capable of being retracted or moved away
32 from the well bore lining or casing so that the work

1 string can be repositioned without the tool making
2 unwanted contact to other parts of the well bore.

3
4 An example of a retractable tool is that disclosed in
5 Patent GB 2,346,629. This tool is mounted on a work
6 string and operates by the application of fluid through
7 the work string. Fluid pressure causes cleaning members
8 in the form of brushes or scrapers to be expanded
9 radially outwards to contact the walls of the well casing,
10 or liner. The work string can be rotated so that the
11 brushes or scrapers clean the walls of the casing or
12 liner. When cleaning is complete a change in fluid
13 pressure causes the cleaning members to be retracted back
14 into the work string so that the work string may be
15 lowered further into the well or be retrieved from the
16 well without the cleaning members making any further
17 contact with the casing or liner. A disadvantage of such
18 systems is that they require changes in fluid pressure
19 from the surface and due to the mechanical components
20 used to assist in the expansion and retraction of the
21 cleaning members they can be prone to failure in hostile
22 environments.

23
24 It is an object of at least one embodiment of the present
25 invention to provide a tool located on a work string,
26 which when it has completed its function in a well bore
27 can be disengaged from the work string such that the work
28 string be run further into the well bore and when
29 retrieved 'pick-up' the tool and remove it from the well
30 bore.

31
32 It is a further object of at least one embodiment of the
33 present invention to provide a tool for insertion in a

1 work string including at least one further tool, which
2 when the string is inserted into the well bore can mill a
3 polished bore receptacle, and remain at the polished bore
4 receptacle while the one or more further tools perform
5 their functions below the polished bore receptacle and is
6 retrieved when the work string is retrieved from the
7 well.

8
9 It is a yet further object of at least one embodiment of
10 the present invention to provide a tool for insertion in
11 a work string which includes a safety feature such that
12 the a portion of the tool will disengage only when the
13 tool has reached a desired location in the well bore.

14
15 According to a first aspect of the present invention
16 there is provided a downhole tool positioned in a work
17 string, the tool including an assembly operable in a well
18 bore via the work string, wherein the assembly is
19 disengagable from the work string at a selected location
20 in the well bore, when disengaged and thereby permitting
21 passage of the work string further into the well bore,
22 and wherein the tool further includes means to pick up
23 the assembly on retrieval from the well bore.

24
25 Preferably the tool comprises a substantially tubular
26 body upon which is located in the assembly.

27
28 Preferably the assembly is a sleeve positioned on an
29 outer surface of the tool. More preferably the assembly
30 is a milling sleeve. Advantageously, the assembly is a
31 milling sleeve suitable for milling a polished bore
32 receptacle in a well bore. Preferably, also the sleeve
33 includes one or more longitudinally arranged milling ribs

1 to dress an internal diameter of the top of the polished
2 bore receptacle. Further the sleeve may include an
3 additional milling portion, scrapers or brushes on an
4 outer surface. Advantageously, the sleeve has a length
5 equal to the length of the polished bore receptacle.

6
7 Preferably, the assembly is operated from the work string
8 by a hex-drive system.

9
10 Preferably the body has a portion of an outer surface
11 having a plurality of longitudinally extending planar
12 sections arranged around a circumference of the body.

13
14 Preferably the assembly includes an inner surface, a
15 portion of which has a plurality of longitudinally
16 extending sections matching those of the body, such that
17 when the body is rotated by virtue of the work string
18 being rotated, the assembly is rotated also.

19
20 Preferably the assembly includes a shoulder on the inner
21 surface thereof, the shoulder providing a ledge upon
22 which a portion of the body engages when the tool is
23 retrieved from the well bore. Advantageously, a portion
24 of the body is that portion provided as a ledge by the
25 plurality of longitudinally extending planar sections.

26
27 Preferably the assembly is detachably coupled to the
28 body. More preferably, the detachable coupling is by one
29 or more shear pins.

30
31 Preferably the assembly has an outer shoulder, the outer
32 shoulder contacting a formation in the well bore to cause
33 the shear pins to shear and decouple the assembly from

1 the body thereby disengaging the assembly from the work
2 string.

3
4 More preferably, the shear pins are arranged so that they
5 take no stress on operation of the assembly from the work
6 string. Advantageously the pins include a constricted
7 portion positioned at a plane between the assembly and
8 the body so that no stress is exacted on the pins when
9 the body is rotated, rotating the assembly with it.

10

11 Preferably also the body and the assembly include means
12 for retaining sheared parts of the sheared pins to
13 prevent them from dispersing into the well bore.

14

15 Preferably the means for retaining sheared parts of the
16 shear pins is by pockets located in the body and the
17 assembly.

18

19 Advantageously the tool includes a safety mechanism to
20 prevent premature decoupling of the assembly prior to the
21 assembly reaching a selected location in the well bore.

22

23 Preferably a safety mechanism operates when the assembly
24 reaches a selected formation at the selected location for
25 the assembly to operate.

26

27 Preferably the safety mechanism comprises a button
28 mounted in a first position to lock the assembly to the
29 tool body, the button having a face engageable with the
30 selected formation, whereupon engagement with the
31 selected formation moves the button from the first
32 position to a second position, disengaging the lock and
33 wherein the selected formation maintains the button in

1 the second position while the selected formation contacts
2 the assembly thereby disengaging the assembly from the
3 work string.

4

5 According to a second aspect of the present invention
6 there is provided a method of running a work string in a
7 well bore to operate more than one tool on a single trip,
8 the method comprising the steps:

- 9 a) locating an assembly operable in a well bore in a work
10 string, the work string including one or more further
11 tools located below the assembly;
12 b) running the work string into the well bore until the
13 assembly reaches a selected location and at this
14 location operating the assembly via the work string;
15 c) disengaging the assembly from the work string at the
16 selected location;
17 d) passing the work string beyond the assembly until the
18 further tools have reached desired locations and
19 performed their functions;
20 e) removing the work string from the well bore; and
21 f) picking up the assembly on the work string as the work
22 string is retrieved.

23

24 Preferably, the assembly is a milling assembly for
25 milling and dressing a polished bore receptacle in the
26 well bore.

27

28 Preferably also the assembly is disengaged from the work
29 string by contacting the assembly with a formation in the
30 well bore and setting down weight on the work string.

31

1 Preferably also the assembly is picked up by the work
2 string by contacting a ledge on the work string with a
3 shoulder on the assembly.

4
5 According to a third aspect of the present invention,
6 there is provided a method of milling a polished bore
7 receptacle in a well bore on the same trip as other
8 functions are performed in the well bore, the method
9 comprising the steps:

- 10 a) mounting a milling assembly in the form of a sleeve
11 including one or more milling elements onto a body
12 in a work string;
- 13 b) connecting a drive between the assembly and the body
14 and coupling the assembly to the body;
- 15 c) inserting the work string in the well bore until the
16 milling assembly reaches the polished bore
17 receptacle;
- 18 d) rotating the work string and thereby through the
19 drive rotating the milling assembly to mill and
20 dress the polished bore receptacle;
- 21 e) resting a portion of the assembly on the top of the
22 polished bore receptacle and setting down weight on
23 the work string to disengage the coupling between
24 the assembly and the body;
- 25 f) running the work string further into the well bore
26 and operating one or more further tools from the
27 work string;
- 28 g) ~~retrieving the work string from the well bore and~~
29 engaging a portion of the body to a shoulder on the
30 assembly so that the assembly is picked up by the
31 work string and retrieved from the well bore.

32

1 Embodiments of the present invention will now be
2 described by way of example only with reference to the
3 following figures in which:

4
5 Figure 1 shows a part cross-sectional view of a downhole
6 tool in accordance with a first embodiment of the present
7 invention;

8
9 Figure 2 shows a cross-sectional along section line A-A
10 of the tool of Figure 1;

11
12 Figure 3 shows an enlarged portion of the downhole tool
13 of Figure 1 illustrating the detachable coupling
14 arrangement; and

15
16 Figure 4 shows a portion of a downhole tool including a
17 safety mechanism according to a third embodiment of the
18 present invention.

19
20 Reference is initially made to Figure 1 of the drawings
21 which illustrates a downhole tool, indicated by reference
22 numeral 10, in accordance with a first embodiment of the
23 present invention. Tool 10 comprises an annular body 12
24 having an axial bore 14 there through. At an upper end 16
25 of the body 12 there is a box section 18 allowing
26 connection of the body 12 onto a work string (not shown).
27 At a lower end 20 of the body 12 is a pin section 22 to
28 allow the body 12 to be threadably connected to the work
29 string (not shown). Therefore the body 12 of tool 10 may
30 be mounted within a work string. This work string may of
31 course have one or more tools located upon it and
32 preferably a tool will be mounted on the work string
33 below the lower end 20 of the tool 10.

1 Mounted on the body 12 is a sleeve 24 comprising two
2 sections. The first is a longitudinal section 26 which
3 mates to the body 12 and typically can be extended to
4 ensure that the sleeves are the required length for the
5 jobs. For example, if the job is to mill a polished
6 bore receptacle (PBR) as shown in Figure 1, section 26
7 will be of a length so that the lower milling section 28
8 can reach to the base of the polished bore receptacle 30.
9 The second is outer section 32 which provides the
10 function of the tool. Section 32 in the first embodiment
11 includes on its surface a plurality of milling ribs 34
12 which when turned will mill and dress the top 36 and
13 inside wall 38 of the PBR 30.

14
15 Body 12 and sleeve 24 are mated together via a plurality
16 of shear pins 40 shown schematically on Figure 1 together
17 with a drive system shown in detail on Figure 2. The
18 drive section is generally referenced by numeral 42. In
19 the embodiment shown here, there are six shear pins
20 holding the body 12 to the sleeve 24. At the mating
21 portion 44 the inner surface 46 of sleeve 24 is provided
22 on a polygon cross-sectional area. In the embodiment
23 shown there are six planar surfaces making up the inner
24 surface 46. A corresponding outer surface 48 is machined
25 on the circumference of the body 12 at mating portion 44.
26 The drive arrangement 42 is thus a hex drive and ensures
27 that when the body 12 is rotated on the work string
28 sleeve 24 will also rotate when surfaces 46 and 48 are
29 aligned. The body 12 and sleeve 24 are held together by
30 the shear screws or shear pins 40.

31
32 With the aid of Figure 3 the arrangement of each shear
33 pin 40 can be seen clearly. Shear pin 40 comprises a

1 screw thread section 50, a constrictive section 52 and a
2 head 54. An aperture 56 in the sleeve 24 ensures that
3 each pin 40 can be inserted and screwed to a matching
4 screw thread in body 12. Pin 40 is inserted to a point.
5 such that the head 54 engages a lip 60 on the sleeve 24.
6 At this point, the constricted section 52, is against the
7 plane 62 formed between the surfaces 46, 48 of the body
8 12 and sleeve 24 respectively. Constricted section 52
9 ensures that when the body 12 is rotated the torque is
10 applied to the surface 46 and not to the shear pins 40.
11 When inserted a plug 64 is screwed into the sleeve 24
12 behind the pin 40 to prevent the ingress of debris to the
13 aperture 56 and to ensure that when pin 40 is sheared the
14 head 54 and sheared portion of the constricted section 52
15 are retained within aperture 56 and cannot exit into the
16 well bore. Conversely the threaded portion 50, which is
17 sheared, remains attached to the body 12 and is likewise
18 prevented from dislodging and entering into the well
19 bore.
20
21 In use sleeve 24 is mounted onto body 12 aligning
22 surfaces 46, 48. Shear pins 40 are inserted through
23 apertures 56 and so that sleeve 24 is coupled to the body
24 12. Tool 10 is then connected into a work string by
25 virtue on sections 18, 22. The work string can then be
26 inserted into the well in the standard manner.
27
28 When the outer portion 32 of sleeve 24 reaches the top 36
29 of the PBR 30, the PBR 30 is then milled and dressed
30 using the milling ribs 34 together with the bore milling
31 section 28 on the sleeve 24. Sleeve 24 is operated
32 purely through rotation of the work string which in turn
33 rotates the body 12 via the hex drive 42. Sleeve 24 is

1 turned and thus milling ribs 34 and milling section 28
2 can mill and dress the inside walls 38 and the top 36 of
3 the PBR 30.

4
5 Once this function is complete the sleeve 24 is located
6 against the PBR 30 at the top 36. The work string is then
7 set down on a weight of approximately 10,000 lbs, top 36
8 acting as a formation in the well bore and the tool then
9 becomes a weight set tool. Setting weight on the tool
10 causes the pins 40 to shear due to the planar arrangement
11 of surfaces 46, 48. The body 12 together with the work
12 string will disengage from the sleeve 24, sleeve 24 will
13 remain at the liner top 36 while the body 12 and work
14 string can descend further into the well bore. A tool
15 connected to the work string (not shown) can then perform
16 any required function at a greater depth in the well
17 bore.

18
19 When all functions are complete in the well bore the work
20 string is removed in the standard manner. When the
21 string brings the meeting portion 44 of the body 12 up to
22 the meeting portion 44 of the sleeve 24 if the surfaces
23 46, 48 do not align the sleeve 24 will be picked up by
24 virtue of the top ledge formed from the surface 46.
25 meeting the bottom ledge formed from surface 48.

26
27 Alternatively, if the surfaces 46, 48 match then the body
28 mating portion 44 slides into the matching mating portion
29 44 of the sleeve. The sleeve 24 is then picked up by the
30 upper ledge formed from the planar sections of the
31 surface 48 now mating with a shoulder 64, see Figure 1,
32 in the sleeve 24. The shoulder 64 is further illustrated

1 in Figure 3. On picking up the sleeve 24, the sleeve 24
2 moves with the body 12 and is removed from the well bore.
3

4 Reference is now made to Figure 4 of the drawings which
5 illustrates a safety mechanism mounted on the sleeve 24
6 of the tool 10 according to a second embodiment of the
7 present invention. The safety mechanism 66 is as
8 disclosed in UK Patent Application No 0126550.3 to the
9 Applicants and is incorporated herein by reference.

10

11 Safety mechanism 66 comprises a cylindrical body or
12 button 68. In one end 70 of the button 68 there is a
13 contact face 72. Face 72 is planar and located at an
14 acute angle to the button 68. At an opposing end 74 there
15 is located a magnet 76. Located between opposing ends
16 70,74 is a narrowed section 78 of the button 68. The
17 narrowed section provides a weak point on the button 68
18 making it susceptible to shearing across the narrow
19 section 78. It will be appreciated that instead of a
20 narrow section the button could include a section of
21 differing material which is weaker than the remaining
22 material and can be equally susceptible to shearing.

23

24 In use, button 68 is inserted through a portion or recess
25 80 of the sleeve 24 and the body 12. The button 68 is
26 positioned such that the narrow section 78 is kept away
27 from plane 62 between the body 12 and sleeve 24. This is
28 achieved by the insertion of bissel pins (not shown).
29 When the tool 10 is inserted into the well bore, the
30 safety mechanism 66 remains in this position until the
31 polished bore receptacle 30 contacts the face 72 of the
32 button 68. On contacting the face 72 the PBR 30 causes
33 the button 68 to be pushed into the recess 80. Once

1 pushed fully in the PBR 30 comes to rest on an upper face
2 82 of the sleeve 24. In this position the PBR 30
3 maintains the button 68 in a position where the narrow
4 section 78 lies on the shear plane 62. The button 68 is
5 held in this position by the inner surface 38 of the PBR
6 30. This contact has caused the sleeve to remain
7 stationary relative to the body 12. Weight applied to
8 the body 12 now causes the shear pins 40 to shear along a
9 narrow section 78 of the safety mechanism 66. Once
10 sheared the sleeve 24 moves relative to the body 12 to
11 allow the work string to become free of the sleeve 24
12 disengaging the milling assembly. While the tool 10 is
13 being set the button 68 is always held inwards where it
14 may be sheared by the continued contact of the surface 38
15 of the PBR 30 with the face 72 of the button 68. This
16 dual function of the PBR 30 in both holding the button 68
17 inwards while contacting the sleeve 24 to set the tool
18 allows the tool only to be set by the PBR 30.

19

20 As setting of the tool occurs only when the PBR provides
21 the dual role of holding the button inwards while
22 contacting the sleeve, it is unlikely that any unintended
23 formation in the well bore could achieve both these
24 functions simultaneously and thus the tool will not
25 operate until it reaches the PBR.

26

27 The principle advantage of the present invention is that
28 it provides a downhole tool which can perform more than
29 one function on a single trip into the well bore. In
30 particular, the tool provides for the milling of a
31 polished bore receptacle while allowing the work string
32 to travel further into the well and perform other
33 functions.

1 A further advantage of the present invention is that it
2 provides a tool, which retrieves all parts thereof on
3 removal from the well.

4

5 A yet further advantage of the present invention is that
6 it includes a safety mechanism to ensure that the
7 assembly only disengages at a selected location in the
8 well bore.

9

10 It will be appreciated by those skilled in the art that
11 various modifications may be made to the invention
12 disclosed herein without departing from the scope
13 thereof. For instance, the description relates to a
14 milling assembly being disengaged on the work string,
15 however other tools can be disengaged such as sensors or
16 cleaning equipment. Presently we have not disclosed
17 other tools suitable for operation in the work string and
18 it will be appreciated by those skilled in the art that
19 any tool may be placed below the assembly to operate on
20 the work string. In fact, it would be possible to
21 include one or more of these assemblies on a single work
22 string, each disengaging at a selected location, as the
23 casing or liner diameter decreases with the depth of the
24 well bore. Further, it will be appreciated that although
25 a hex drive mechanism is shown to drive the assembly from
26 the work string, any drive mechanism which can disengage
27 and decouple allowing free passage of a work string
28 through the assembly would be suitable. Additionally, in
29 this respect the number of shear pins required to hold
30 the assembly to the work string on its descent into the
31 well may be varied.

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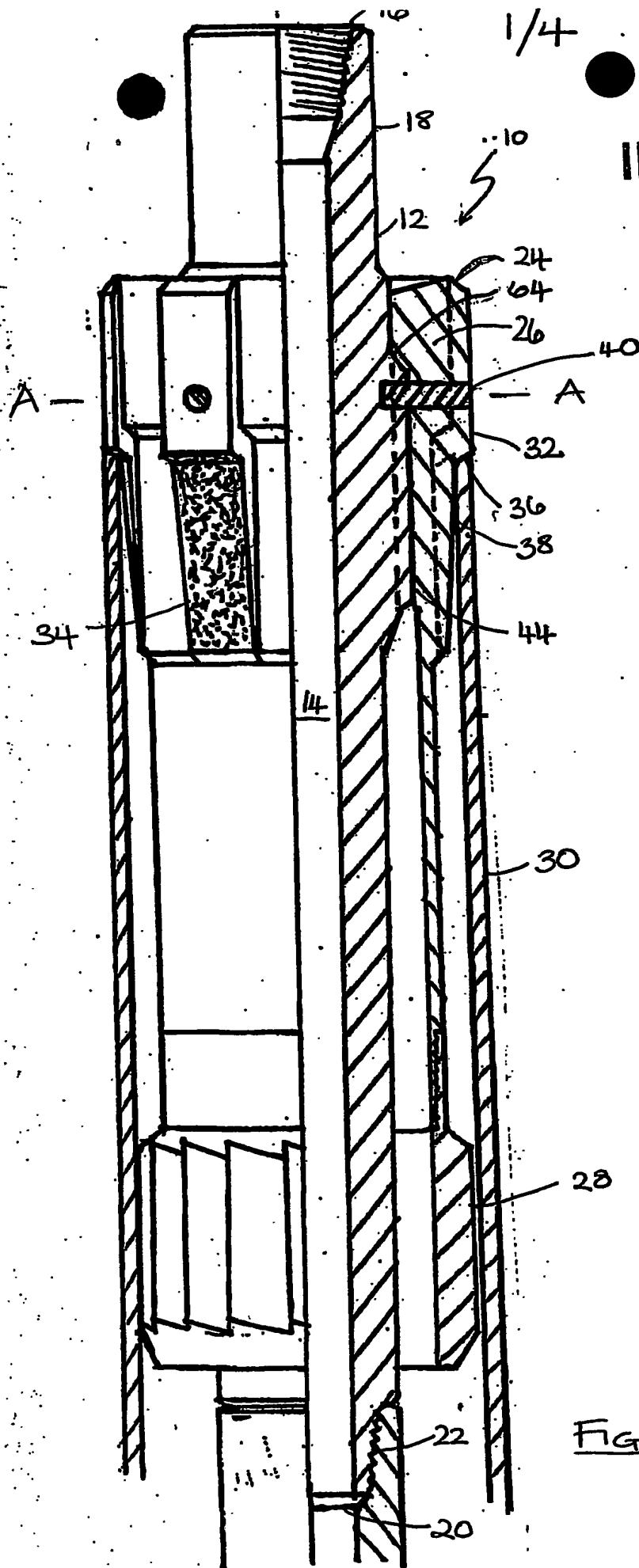


FIGURE 1

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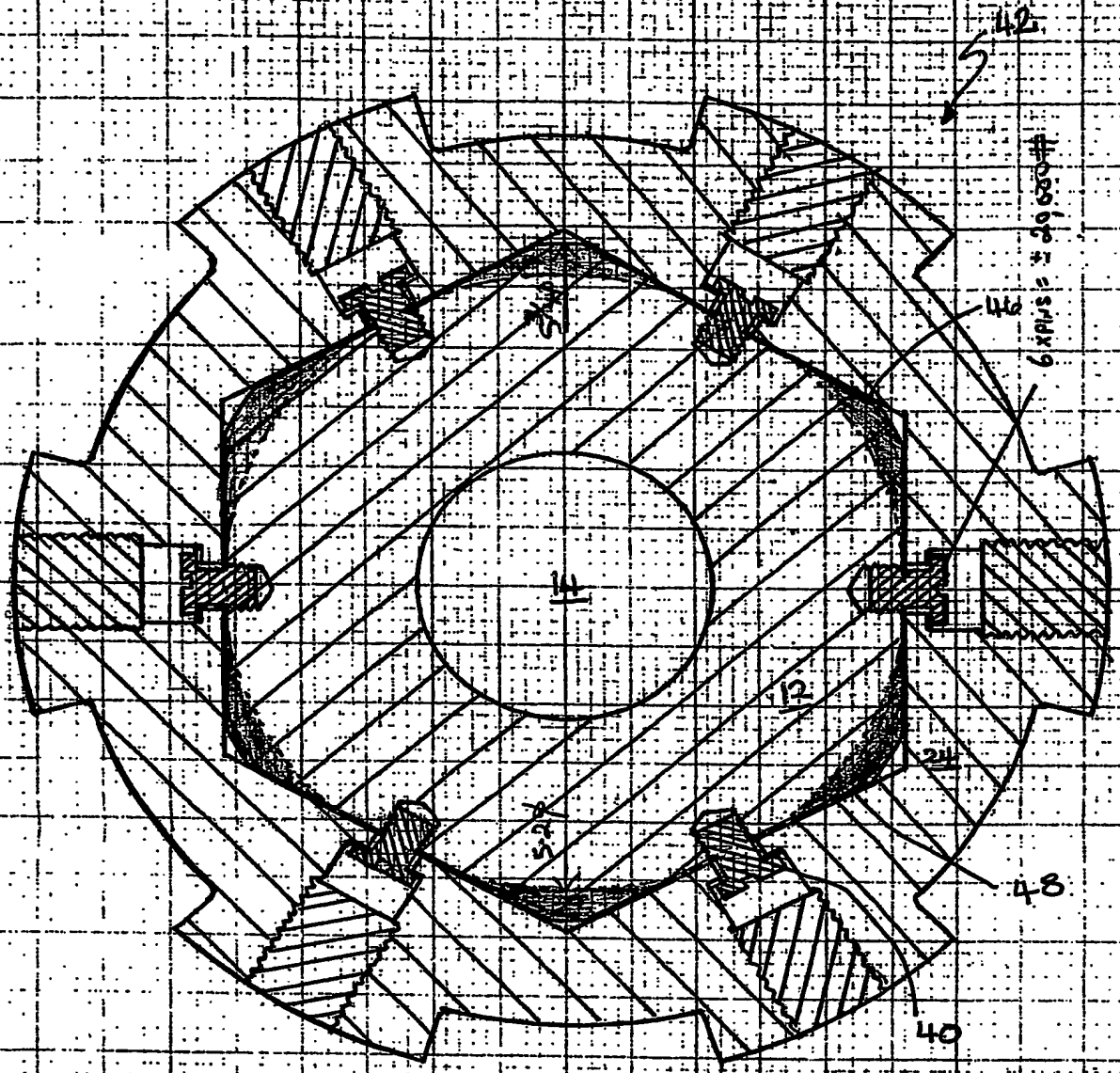
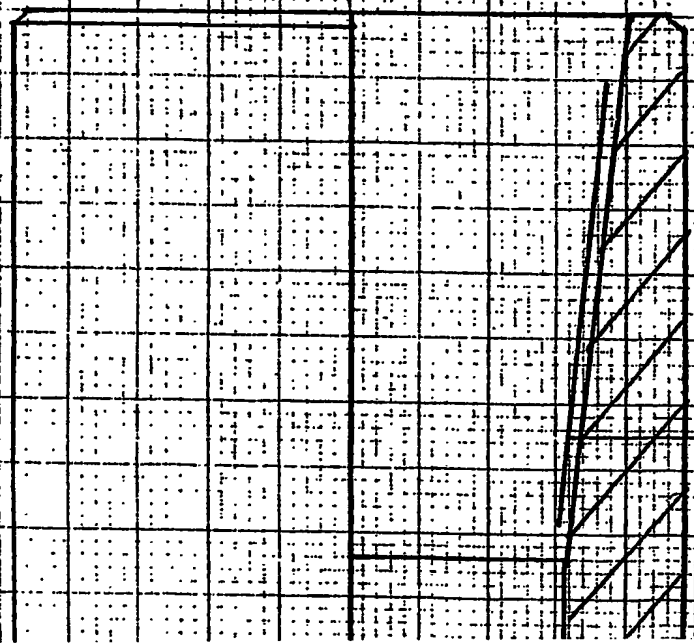
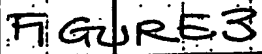


FIGURE 2



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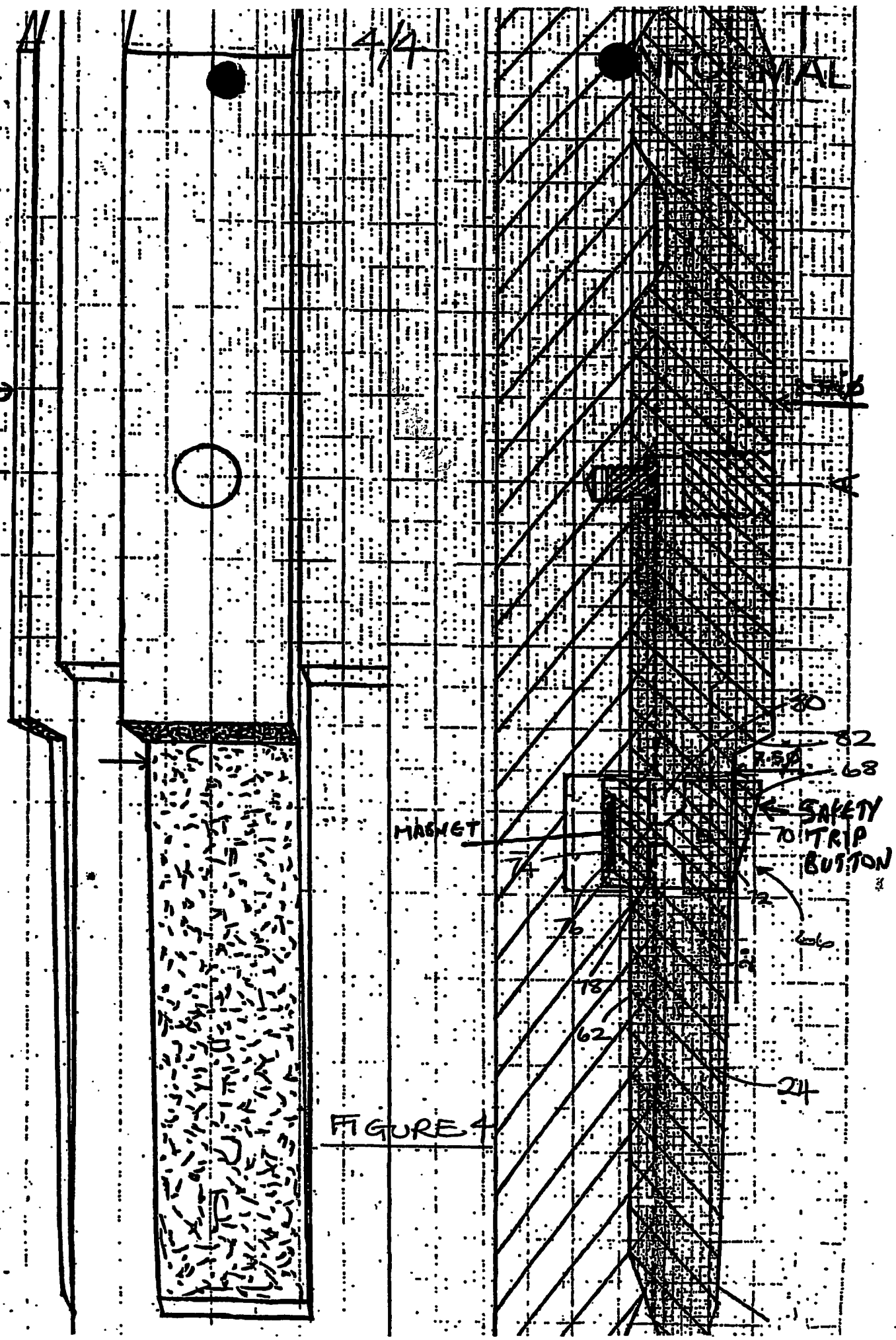


FIGURE 4

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